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Abstract: Since April, 1956, when an injured whooping crane (*Grus americana*) was received for rehabilitation, the San Antonio Zoo has maintained these birds in the collection and is 1 of only 2 zoos to have raised them. The zoo's management efforts, combined with favorable climatic conditions and water sources have contributed to a successful breeding program. The whooping crane is 1 of 7 crane species successfully bred, and 1 of 8 crane species currently in the collection.

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The chronology of the relationship between the San Antonio Zoo and the whooping crane began well before the arrival of the adult bird named "Rosie" in 1956. Official zoo records are incomplete prior to 1969, but newspaper clippings indicate that at least a few whooping cranes found their way into Zoo Director Fred Stark's hands well before Rosie. All had been seriously injured during migration and none survived. In 1951, a bird dubbed "Howard" came in from Aransas Wildlife Refuge, about 150 miles from the zoo, with a leg broken by a gunshot. In November 1952, a bird later named "Queenie Victoria" was picked up in Saskatchewan with a broken wing, broken leg and lung inflammation. Part of the wing was amputated, and the bird was flown to San Antonio where it died 3 days after arrival.

In early June 1956, "Rosie" was found on the Edd Kirby ranch near Lometa, Texas in Lampasas County, north of San Antonio, and brought to the zoo. She had a broken wing, but survived the injury and remained at the zoo alone for 8 years. In 1964, Rosie was sent to Audubon Park Zoo in New Orleans in hopes that she would pair with one of the whooping crane offspring produced there in 1957. That pairing failed, and when "Josephine", the mate of "Crip", died at Audubon Park in 1965, Rosie was made available as his new mate. Rosie and Crip did not nest in 1966 and on 1 January 1967, they were shipped to the San Antonio Zoo. Eggs were laid there 7 & 9 June 1967, both of which hatched. The first chick was stepped on by one of the parents the day after hatching and died, so the second, "Tex," was removed and taken to Fred Stark's house on the zoo grounds where she was tended until, at age 16 days, she was sent to the Patuxent Wildlife Research Center in Laurel, Maryland.

Records for 1968 eggs conflict, reporting anywhere from 1 to 5 eggs having been laid, none of which apparently hatched. Dates also conflict (Maraldo 1980).

In 1969, Crip and Rosie commenced laying earlier than previous years and produced 6 eggs, layed 25 and 29 April and 6, 12, and 16 May and 6 June. The first egg was broken by the parents, and eggs #2 through #5 were sent to Patuxent for artificial incubation. Eggs #2 through #4 were infertile and egg #5 was fertile, but the embryo died at 10 days. The 6th egg, which remained under the parents, hatched on 5 July, producing "Firecracker". Firecracker developed slipped tendons and died 11 July.

On 15 February 1970, the zoo began a new phase in its management of the cranes when 12, 150-watt spotlights were installed in the whoopers' pen to manipulate photoperiod. Length of daylight was increased to simulate that on their normal breeding grounds. The first egg of that season was laid 20 March, 1 month earlier than previously, and it was fertile. Eight eggs were laid that season: 20, 22, and 29 March, 3, 9, 13, and 24 April, and 11 May. The first 7 were sent to Patuxent for incubation, 5 of which were fertile. Only the 24 April egg hatched, and the chick died at 2 days. The 8th egg remained with the adults, but a heavy rainstorm 26 June flooded the nest, and the floating egg had to be moved to an artificial incubator where it exploded a few weeks later.

The following breeding season, San Antonio was in the midst of a prolonged drought. Rosie produced no eggs that season, and on the morning of 16 June 1971, Rosie was found down in the enclosure and died that afternoon in spite of intensive medical care. She had been in captivity for 15 years and was of unknown age. The carcass was

sent to Patuxent for a necropsy which revealed a liver tumor (Maraldo 1980).

Crip remained alone for the next several years until 1976 when an adult female, "Ektu" was sent from Patuxent. Ektu had been raised at Patuxent from an egg collected in 1967 at Wood Buffalo National Park, Canada. On 29 April of that year, Ektu and Crip were seen dancing, the first observed sign of compatability. Ektu laid her first egg at San Antonio 2 years later on 18 April 1978. It was fertile and was sent to Patuxent for incubation, but the embryo died before hatching. There were no more eggs in 1978, but in 1979, 5 eggs were laid: 11, 14, 18, 21, and 26 March. At least 3 were fertile although none hatched. Then, on 27 March, 1979, Crip collapsed and died. He had been in captivity 33 years and was an adult bird when originally captured, so he was at least 35 years old. Necropsy results showed he died of pericardial tamonade caused by cardiac hemorrhage.

Ektu produced 3 more eggs that season, on 29 March and 5 and 8 April. One was fertile and on 26 April, "Criptu" hatched under a broody red junglefowl hen (*Gallus gallus*). He was allowed to remain with this foster mother for a while, but in August was put with his mother after having gained adult size and juvenile plumage. Ektu accepted him, and they remained together until 30 November 1979 when they were both shipped to Patuxent. Criptu died at Patuxent one month after his arrival.

A new pair of cranes arrived from Patuxent at this time. "Pax", the male, had been a semen donor for Patuxent's artificial insemination program. "Klewi", the female, was 10 years old. Their regular unison calling indicated that a bond had or was forming, but in 1980 and 1981 no eggs were produced. Finally, on 21 March 1982, a broken thin-shelled egg was found. It was infertile. The prospect of infertile eggs for the 1983 season prompted the initiation of artificial insemi-nation procedures on 13 March. The first egg, laid 14 March, was found as fragments of thin shell. The 2nd, laid 19 March, was normal in shape but infertile. By the end of the season, it had become apparent that there was a problem with Pax. His plumage was beginning to look worn and the comb was pale. Pax's behavior remained as always, active and vigorous, but it became difficult, then impossible, to collect semen from him.

So that the 1984 season might not be lost, fresh semen was sent from Patuxent. In the meantime, skin scrapings, fecals, and blood samples were taken from Pax, but all tests were inconclusive. Three eggs were laid during the 1984 season, all under the imported semen program, and the last one, laid 29 March, was fertile. However, the embryo died at an early stage of incubation.

In January of 1985, Pax and Klewi were returned to Patuxent and a juvenile male, "Bubba", who hatched at Patuxent in May 1984 came to San Antonio. He developed normally and shared his enclosure with a pair of cackling geese (*Branta canadensis canadensis*) for the first two years. As he has matured, he has begun responding vocally to the pair of hooded cranes in the adjoining enclosure.

The zoo currently exhibits 8 crane species and has bred 7, Lilford's crane (*Grus grus lilfordi*), east African crowned cranes (*Balearica pavonina gibbericeps*), stanley cranes (*Anthropoides paradisea*), demoiselle cranes (*Anthropoides virgo*), sarus cranes (*Grus antigone*), hooded cranes (*Grus monacha*), and whoopers.

Most cranes are managed in similar manner in enclosures approximately 9.0 meters x 12.0 meters x 2.7 meters with shallow streams running through one end. The pens are landscaped with shrubs, cane, trees and grasses (Appendix 1) as well as rocks, stumps, and logs. Only the fronts of the enclosures are accessible to the public and pairs of cranes are separated from each other by visual barriers. The public walkway is elevated from the birds' ground level and eye level for them is a solid wall. Feeders are usually hung over water, but when a pair is raising chicks, the feeders are moved near access doors to allow keepers to service the enclosures with minimal disturbance. All cranes are fed a pellet diet modeled after the Ziegler Brothers Maintainer and Breeder crane diets, and chicks are raised on Crane Starter (Ziegler Bros. Inc., P.O. Box 95, Gardners, PA 17324-0095). All are provided oyster shell grit daily, as well as a few mealworms or smelt. Live fish and crayfish are available in the natural stream.

Photoperiod manipulation has been done only with whoopers and hooded cranes (Appendix 2), and with the exception of the single pair of whoopers, all breeding has been natural. Parental incubation is much preferred, but if a pair has demonstrated a lack of ability or if multiple-clutching is desired, eggs are pulled for incubation under broody red junglefowl hens or other cranes. Chicks hatched under the foster mothers are usually hand-raised in the brooder facility, but chicks hatched under parents are left with them unless problems arise. Chicks left with the parents are dewormed and given prophylactic antibiotics within 2 days of

hatching (2 mg./chick Amikacin and 50 mg./gm. body wt. Fenbendazole). Then, depending on the species, chicks are wormed again weekly or bi-weekly until they develop juvenile plumage. The chick starter diet is provided 3 times daily along with mealworms. A parasitic eye fluke, *Philopthalrnus gralli* (see Toft et. al. 1980) is present in the river water flowing through the enclosures, so chicks are prevented by use of a canvas barrier from entering the water until approximately 45 days old, by which time they have developed a natural immunity.

LITERATURE CITED

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SUMMARY OF WHOOPING CRANE RECORDS AT SAN ANTONIO ZOO

4- -56	**Rosie captured & brought to San Antonio Zoo**		
4-1-64	**Rosie sent to New Orleans**		
1-5-67	**Crip, Rosie, returned to San Antonio Zoo**		
6-7-67	Egg #1	Parental Incubation	Hatched 7-6-67 & chick stepped on 7-7-67
6-9-67	Egg #2	Parental incubation	Hatched 7-9-67 & hand reared-"Tex"
6-25-67	**Tex returned to Patuxent**		
1968	Eggs reported vary— 1 to 5. No hatch.		
4-25-69	Egg #1	Broken by parents	
4-29-69	Egg #2	Sent to Patuxent	Infertile
5-06-69	Egg #3	Sent to Patuxent	Infertile
5-12-69	Egg #4	Sent to Patuxent	Infertile
5-16-69	Egg #5	Sent to Patuxent	Fertile but embryo died at 10 days
6-6-69	Egg #6	Parental incubation	Hatched 7-5-69 "Firecracker", male died 7-11-69
2-15-70	**Photoperiod manipulation begun**		
3-20-70	Egg #l	Sent to Patuxent	Fertile-no hatch
3-22-70	Egg #2	Sent to Patuxent	Fertile-no hatch
3-29-70	Egg #3	Sent to Patuxent	Infertile
4-03-70	Egg #4	Sent to Patuxent	Fertile-no hatch
4-09-70	Egg #5	Sent to Patuxent	Infertile
4-13-70	Egg #6	Sent to Patuxent	Fertile-died
4-24-70	Egg #7	Sent to Patuxent	Fertile-hatched,died at 2 days
5-11-70	Egg #8	Parental incubation	Nest flooded, egg moved to incubator, exploded
6-16-71	**Death of Rosie**		

SUMMARY OF WHOOPING CRANE RECORDS AT SAN ANTONIO ZOO (continued)

2-11-76	**Ektu received from Patuxent**		
4-29-76	**Ektu & Crip dancing-first date of no fighting**		
4-18-78	Egg #1	Sent to Patuxent	Fertile-died
3-11-79	Egg #1	Sent to Patuxent	Infertile
3-14-79	Egg #2	Sent to Patuxent	Infertile
3-18-79	Egg #3	Artificial incubation(SAZ)	Fertile-pipped & died
3-21-79	Egg #4	Artificial incubation(SAZ)	Infertle
3-26-79	Egg #5	Sent to Patuxent	Fertile
3-27-79	**Death of Crip**		
3-29-79	Egg #6	Sent to Patuxent	
4-05-79	Egg #7	Artificial incubation	Infertile
4-08-79	Egg #8	Artificial incubation	Fertile-hatched 4-26-79 "Criptu"
11-28-79	**Pax & Klewi received from Patuxent**		
11-30-79	**Ektu & Criptu sent to Patuxent**		
1980	No eggs		
1981	No eggs		
3-21-82	Egg # 1		Broken, bluish,thin egg shell
3-25-82	Egg #2		No shell
4-05-82	Egg #3	Art.inc., then broody hen	Infertile, abnormal elongated shape
3-13-83	**Artificial insemination begun**		
3-14-83	Egg #l		Fragments of bluish shell
3-19-83	Egg 2		No shell
3-02-84	**Artificial insemination begun**		
3-10-84	Egg # 1	Incubator 3-1 2-84,then Demoiselle crane 3-22-84	Infertile
3-12-84	Egg #2	Parents, then artificial incubation 3-16-84	Infertile
3-29-84	Egg #3	Broody hen	Fertile, early death
1-29-85	**#8449 "Bubba" received from Patuxent**		
1-30-85	**Pax & Klewi sent to Patuxent**		

Appendix 1
CRANE ENCLOSURE VEGETATION

COMMON NAME	SCIENTIFIC NAME
Pittosporum	*Pittosporum tobira*
Georgia cane	*Arundo donax*
Umbrella grass	*Cyperus alternifolia*
Rye grass	*Lolium multiflorum*
Fescue grass (Kentucky 31)	*Festuca arundinacea*
St. Augustine grass	*Stenotaphrum secundatum*
Pampas grass	*Cortaderia argentea*
Dwarf bamboo	*Bambusa falcata*
Sycamore tree	*Platanus occidentalis*
Mulberry tree	*Morus alba*
Ligustrum	*Ligustrum ovalifoleum*
Ligustrum	*Ligustrum japonica*
Dwarf yaupon	*Llex vomitoria 'Nana'*
Juniper	*Juniperus chinensis* 'pfitzeriana'
Swamp lily	*Canna* (spp.)

APPENDIX II

SAMPLE PHOTOPERIOD REGIMEN FOR WHOOPING AND HOODED CRANES - SAN ANTONIO ZOO

DATE	SUNRISE	SUNSET	NATURAL PERIOD	ARTIFICIAL PERIOD	HOURS PHOTO-PERIOD	ON	OFF
2-6-87	7:21	6:15	10 hrs, 54 min	2 hrs, 06 min	13 hrs	5:15	8:00
2-13-87	7:16	6:21	11 hrs, 05 min	2 hrs, 55 min	14 hrs	4:21	8:00
2-20-87	7:10	6:26	11 hrs, 16 min	3 hrs, 44 min	15 hrs	3:26	8:00
2-27-87	7:03	6:31	11 hrs, 28 min	4 hrs, 42 min	16 hrs	2:21	8:00
3-6-87	6:56	6:36	11 hrs, 40 min	5 hrs, 20 min	17 hrs	1:36	8:00
3-13-87	6:48	6:40	11 hrs, 52 min	6 hrs, 18 min	18 hrs	12:30	8:00
3-20-87	6:39	6:45	12 hrs, 06 min	6 hrs, 54 min	19 hrs	11:45	8:00
3-27-87	6:31	6:49	12 hrs, 18 min	7 hrs, 42 min	20 hrs	10:49	8:00
4 -3-87	6:23	6:53	12 hrs, 30 min	8 hrs, 30 min	21 hrs	9:53	8:00
Daylight savings							
4-10-87	7:15	7:57	12 hrs, 42 min	9 hrs, 18 min	22 hrs	9:57	8:30
4-17-87	7:07	8:00	12 hrs, 53 min	9 hrs, 07 min	22 hrs	10:00	8:00
4-24-87	6:59	8:05	13 hrs, 06 min	8 hrs, 54 min	22 hrs	10:05	8:00
5-1-87	6:53	8:10	13 hrs, 17 min	8 hrs, 43 min	22 hrs	10:10	8:00
5-15-87	6:42	8:19	13 hrs, 37 min	8 hrs, 23 min	22 hrs	10:19	8:00